DATA SHEET

TEA5570
RF/IF circuit for AM/FM radio

Product specification
File under Integrated Circuits, IC01

September 1987

Philips Semiconductors

PHILIPS

GENERAL DESCRIPTION

The TEA5570 is a monolithic integrated radio circuit for use in portable receivers and clock radios. The IC is also applicable to mains-fed AM and AM/FM receivers and car radio-receivers. Apart from the AM/FM switch function the IC incorporates for AM a double balanced mixer, 'one-pin' oscillator, i.f. amplifier with a.g.c. and detector, and a level detector for tuning indication. The FM circuitry comprises i.f. stages with a symmetrical limiter for a ratio detector. A level detector for mono/stereo switch information and/or indication complete the FM part.

Features

- Simple d.c. switching for AM to FM by only one d.c. contact to ground (no switch contacts in the i.f. channel, a.f. or level detector outputs)
- AM and FM gain control
- Low current consumption (I_{tot} = 6 mA)
- Low voltage operation (V_P = 2,7 to 9 V)
- Ability to handle large AM signals; good i.f. suppression
- Applicable for inductive, capacitive and diode tuning
- Double smoothing of a.g.c. line
- Short-wave range up to 30 MHz
- Lumped or distributed i.f. selectivity with coil and/or ceramic filters
- AM and a.g.c. output voltage control
- Distribution of PCB wiring provides good frequency stability
- Economic design for 'AM only' receivers.

QUICK REFERENCE DATA (at T_{amb} = 25 °C)

Supply voltage	$V_P = V_{7-16}$	typ.	5,4	V
Supply current	I_7	typ.	6,2	mA
AM performance (pin 2) for m = 0,3				
Sensitivity				
at V_o = 10 mV	V_i	typ.	1,7	μV
at S/N = 26 dB	V_i	typ.	16	μV
A.F. output voltage at V_i = 1 mV	V_o	typ.	100	mV
Total harmonic distortion at V_i = 1 mV	THD	typ.	0,5	%
FM performance (pin 1) for Δf = ± 22,5 kHz				
limiting sensitivity, –3 dB	V_i	typ.	110	μV
Signal-to-noise ratio for V_i = 1 mV	S/N	typ.	65	dB
A.F. output voltage at V_i = 1 mV	V_o	typ.	100	mV
Total harmonic distortion at V_i = 1 mV	THD	typ.	0,3	%
AM suppression at V_i = 10 mV	AMS	typ.	50	dB

PACKAGE OUTLINE

16-lead DIL; plastic (SOT38); SOT38-1; 1996 July 25.

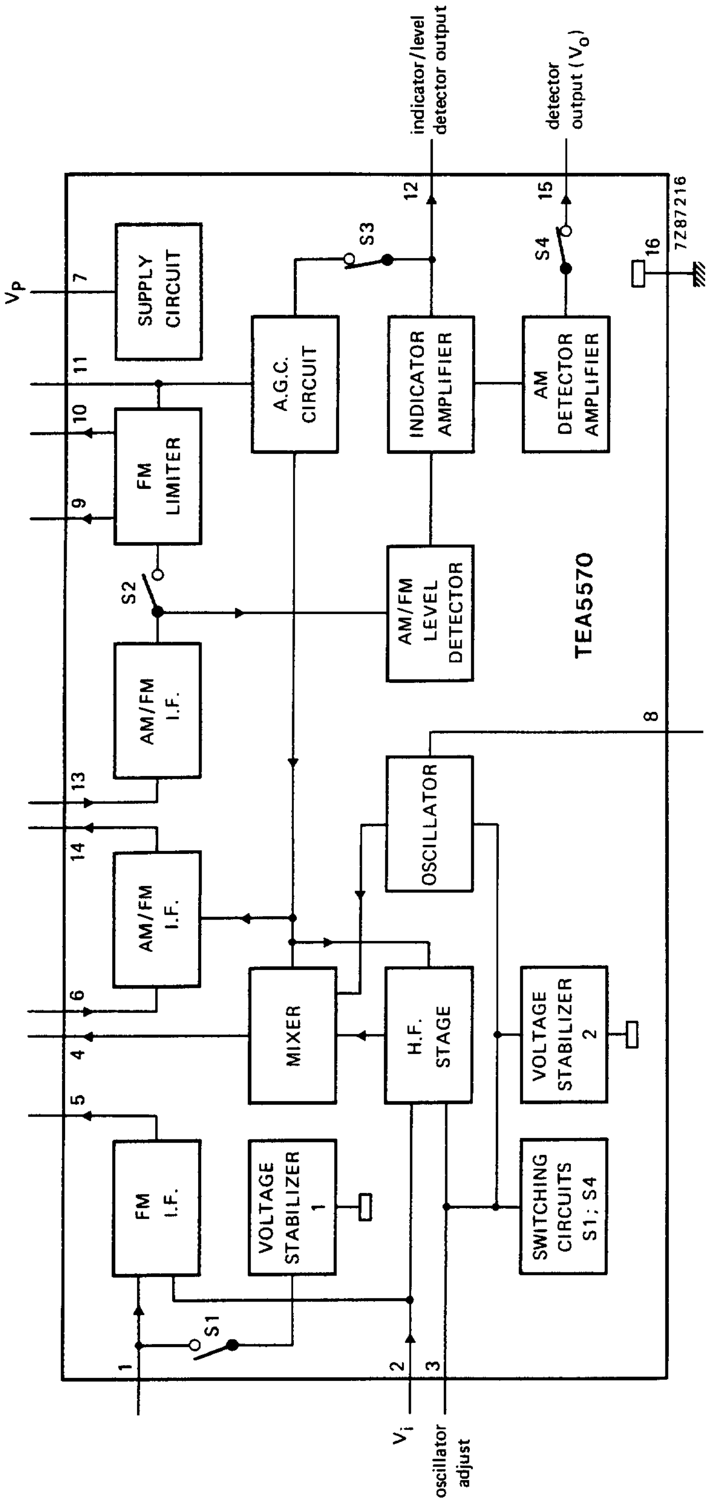


Fig.1 Block diagram.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Supply voltage (pin 7)	$V_P = V_{7\text{-}16}$	max.	12 V
Voltage at pins 4, 5, 9 and 10 to pin 16 (ground)	$V_{n\text{-}16}$	max.	12 V
Voltage range at pin 8	$V_{8\text{-}16}$		$V_P \pm 0{,}5$ V
Current into pin 5	I_5	max.	3 mA
Total power dissipation	P_{tot}	see Fig.2	
Storage temperature range	T_{stg}	–55 to	+ 150 °C
Operating ambient temperature range	T_{amb}	–30 to	+ 85 °C

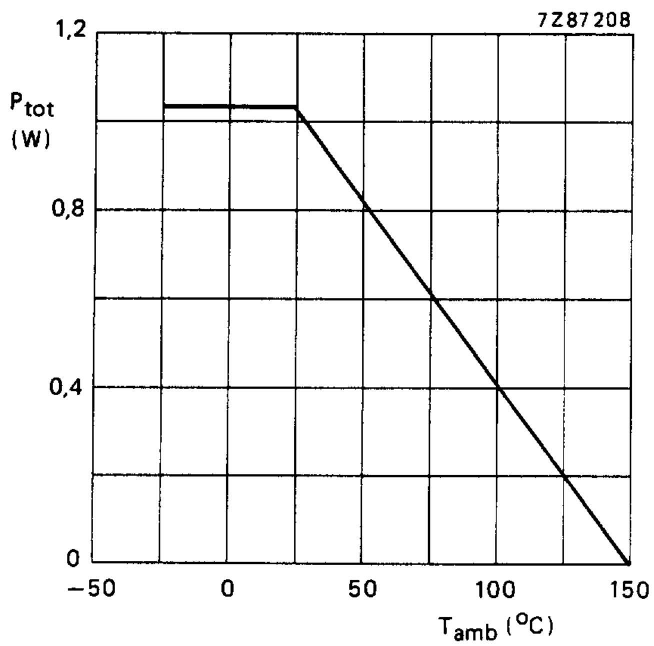


Fig.2 Power derating curve.

D.C. CHARACTERISTICS

V_P = 6 V; T_{amb} = 25 °C; measured in Fig.10; unless otherwise specified

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply (pin 7)					
Supply voltage (note 1)	$V_P = V_{7-16}$	2,4	5,4	9,0	V
Voltages					
at pin 1 (FM)	V_{1-16}	–	1,42	–	V
at pin 1; $-I_1$ = 50 µA (FM)	V_{1-16}	–	1,28	–	V
at pins 2 and 3 (AM)	$V_{2,3-16}$	–	1,42	–	V
at pin 6	V_{6-16}	–	0,7	–	V
at pin 11	V_{11-16}	–	1,4	–	V
at pin 13	V_{13-16}	–	0,7	–	V
at pin 14	V_{14-16}	–	4,3	–	V
Currents					
Supply current	I_7	4,2	6,2	8,2	mA
Current supplied from pin 1 (FM)	$-I_1$	–	–	50	µA
Current supplied from pin 12	$-I_{12}$	–	–	20	µA
Current supplied from pin 15	$-I_{15}$	–	30	–	µA
Current into pin 4 (AM)	I_4	–	0,6	–	mA
Current into pin 5 (FM) (note 4)	I_5	–	0,35	–	mA
Current into pin 8 (AM)	I_8	–	0,3	–	mA
Current into pins 9, 10 (FM)	$I_{9,10}$	–	0,65	–	mA
Current into pin 14	I_{14}	–	0,4	–	mA
Power consumption	P	–	40	–	mW

A.C. CHARACTERISTICS

AM performance

V_P = 6 V; T_{amb} = 25 °C; r.f. condition: f_i = 1 MHz, m = 0,3, f_m = 1 kHz; transfer impedance of the i.f. filter $|Z_{tr}|$ = v_6/I_4 = 2,7 kΩ; measured in Fig.10; unless otherwise specified

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
R.F. sensitivity (pin 2)					
at V_o = 30 mV	V_i	3,5	5,0	7,0	μV
at S + N/N = 6 dB	V_i	–	1,3		μV
at S + N/N = 26 dB	V_i	–	16	20	μV
at S + N/N = 50 dB	V_i	–	1	–	mV
Signal handling (THD ≤ 10% at m = 0,8)	V_i	200	–	–	mV
A.F. output voltage at V_i = 1 mV	V_o	80	100	125	mV
Total harmonic distortion					
at V_i = 100 μV to 100 mV (m = 0,3)	THD	–	0,5	–	%
at V_i = 2 mV (m = 0,8)	THD	–	1,0	2,5	%
at V_i = 200 mV (m = 0,8)	THD	–	4,0	10	%
I.F. suppression at V_o = 30 mV (note 2)	α	26	35	–	dB
Oscillator voltage (pin 8; note 3)					
at f_{osc} = 1455 kHz	$V_{8\text{-}16}$	120	160	200	mV
Indicator current (pin 12) at V_i = 1 mV	I_{12}	–	200	230	μV

FM performance

V_P = 6 V; T_{amb} = 25 °C; i.f. condition: f_i = 10,7 MHz, Δf = ± 22,5 kHz, f_m = 1 kHz; transfer impedance of the i.f. filter $|Z_{tr}|$ = v_6/i_5 = 275 Ω; measured in Fig.10; unless otherwise specified

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
I.F. part					
I.F. sensitivity (adjustable; note 4)					
Input voltage					
at –3 dB before limiting	V_i	90	110	130	μV
at S + N/N = 26 dB	V_i	–	6	–	μV
at S + N/N = 65 dB	V_i	–	1	–	mV
A.F. output voltage at V_i = 1 mV	V_o	80	100	125	mV
Total harmonic distortion at V_i = 1 mV	THD	–	0,3	–	%
AM suppression (note 5)	AMS	–	50	–	dB

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Indicator/level detector (pin 12)					
Indicator current	I_{12}	–	250	325	μA
D.C. output voltage					
at V_i = 300 μV	$V_{12\text{-}16}$	–	0,25	–	V
at V_i = 2 mV	$V_{12\text{-}16}$	–	1,0	–	V
AM to FM switch					
Switching current at $V_{3\text{-}16}$ < 1 V	$-I_3$	–	–	400	μA

Notes to the characteristics

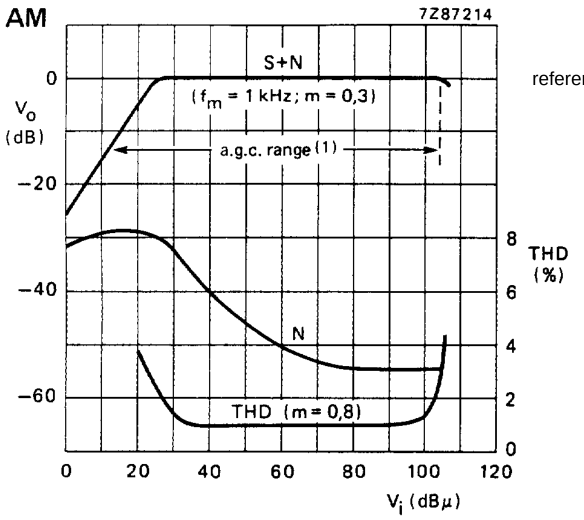
1. Oscillator operates at $V_{7\text{-}16}$ > 2,25 V.
2. I.F. suppression is defined as the ratio $\alpha = 20 \log \frac{V_{i1}}{V_{i2}}$ where: V_{i1} is the input voltage at f = 455 kHz and V_{i2} is the input voltage at f = 1 MHz.
3. Oscillator voltage at pin 8 can be preset by R_{osc} (see Fig.10).
4. Maximum current into pin 5 can be adjusted by R1 (see Fig.10); $I_5 = \frac{V_{3-16}}{R1} - I_3$ when $V_{3\text{-}16}$ = 800 mv; I_3 = 400 μA.
5. AM suppression is measured with f_m = 1 kHz, m = 0,3 for AM; f_m = 400 Hz, Δf = ± 22,5 kHz for FM.

Facility adaptation

Facility adaptation is achieved as follows (see Fig.10):

FACILITY	COMPONENT
FM sensitivity	R1 fixes the current at pin 5 ($I_5 = \frac{V_{3-16}}{R1}$ – 400 μA)
	(gain adjustable ± 10 dB; see note 4)
AM sensitivity	R11 and coil tapping
AM oscillator biasing	R_{osc}
AM output voltage	R7, R11
AM a.g.c. setting	R7

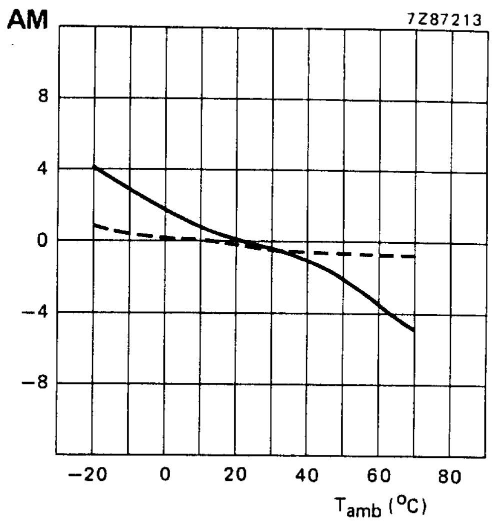
Typical graphs



reference level 0 dB = 100 mV

(1) A.G.C. range (figure of merit, FOM).

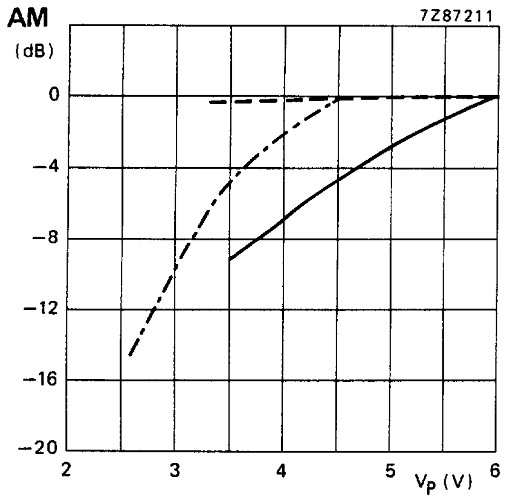
Fig.3 Signal, noise and distortion as a function of input voltage (V_i). Measured at f_i = 1 MHz in test circuit Fig.10.



——— sensitivity (V_i) at V_o = 30 mV; m = 0,3.

– – – output voltage (V_o) at V_i = 2 mV; m = 0,3.

Fig.4 Sensitivity (V_i), output voltage (V_o) as a function of temperature behaviour (T_{amb}). Measured at f_i = 1 MHz in test circuit Fig.10.



——— sensitivity (V_i) at V_o = 30 V; m = 0,3: 6,0 V application.
– – – – – sensitivity (V_i) at V_o = 30 mV; m = 0,3: 4,5 V application.
– – – – – output voltage (V_o) at V_i = 0,2 mV; m = 0,3.

Fig.5 Sensitivity (V_i) and output voltage (V_o) as a function of supply voltage (V_P). Measured at f_i = 1 MHz in test circuit Fig.10, for application V_P = 6 V. Also shown is the sensitivity for V_P = 4,5 V application (Fig.16).

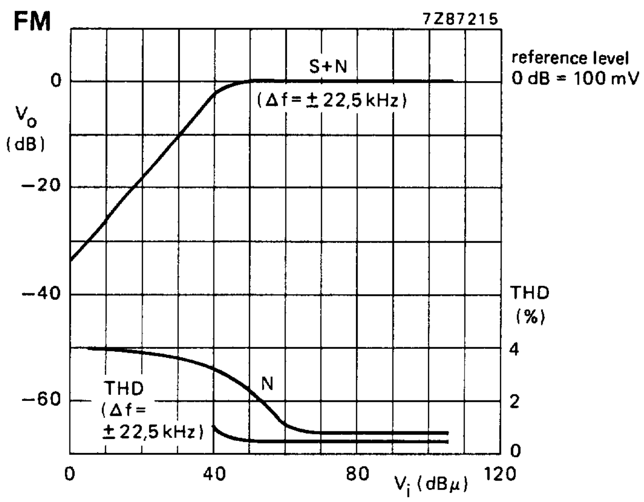
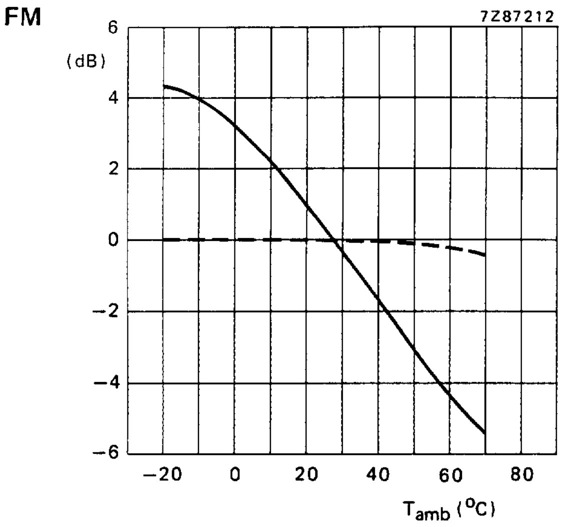
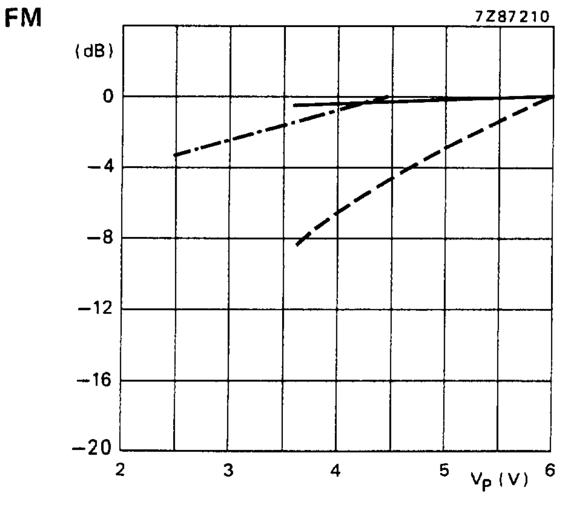


Fig.6 Signal, noise and distortion as a function of input voltage (V_i). Measured at f_i = 10,7 MHz in test circuit Fig.10.



——— sensitivity at –3 dB limiting.
– – – output voltage (V_o) at V_i = 1 mV; Δf = ± 22 kHz.

Fig.7 Sensitivity (V_i), output voltage (V_o) as a function of temperature behaviour (T_{amb}). Measured at f_i = 10,7 MHz in test circuit Fig.10.



——— sensitivity at –3 dB limiting: V_P = 6,0 V application.
- - - - - - sensitivity at –3 dB limiting: V_P = 4,5 V application.
– – – – output voltage (V_o) at V_i = 1 mV; Δf = ± 22,5 kHz.

Fig.8 Sensitivity (V_i) and output voltage (V_o) as a function of supply voltage (V_P). Measured at f_i = 10,7 MHz in test circuit Fig.10.

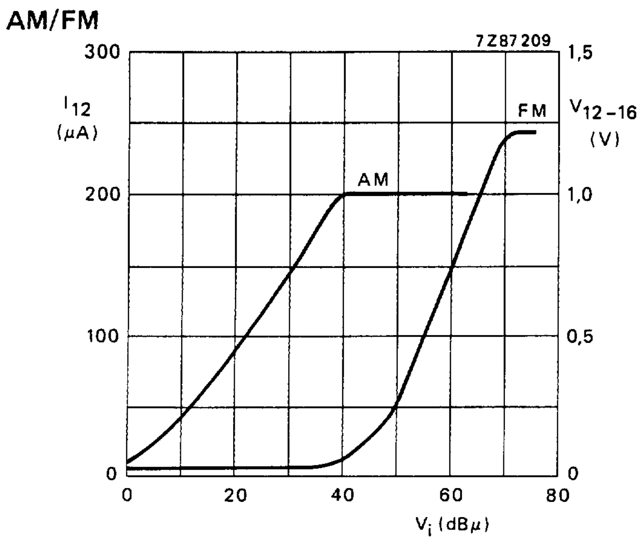
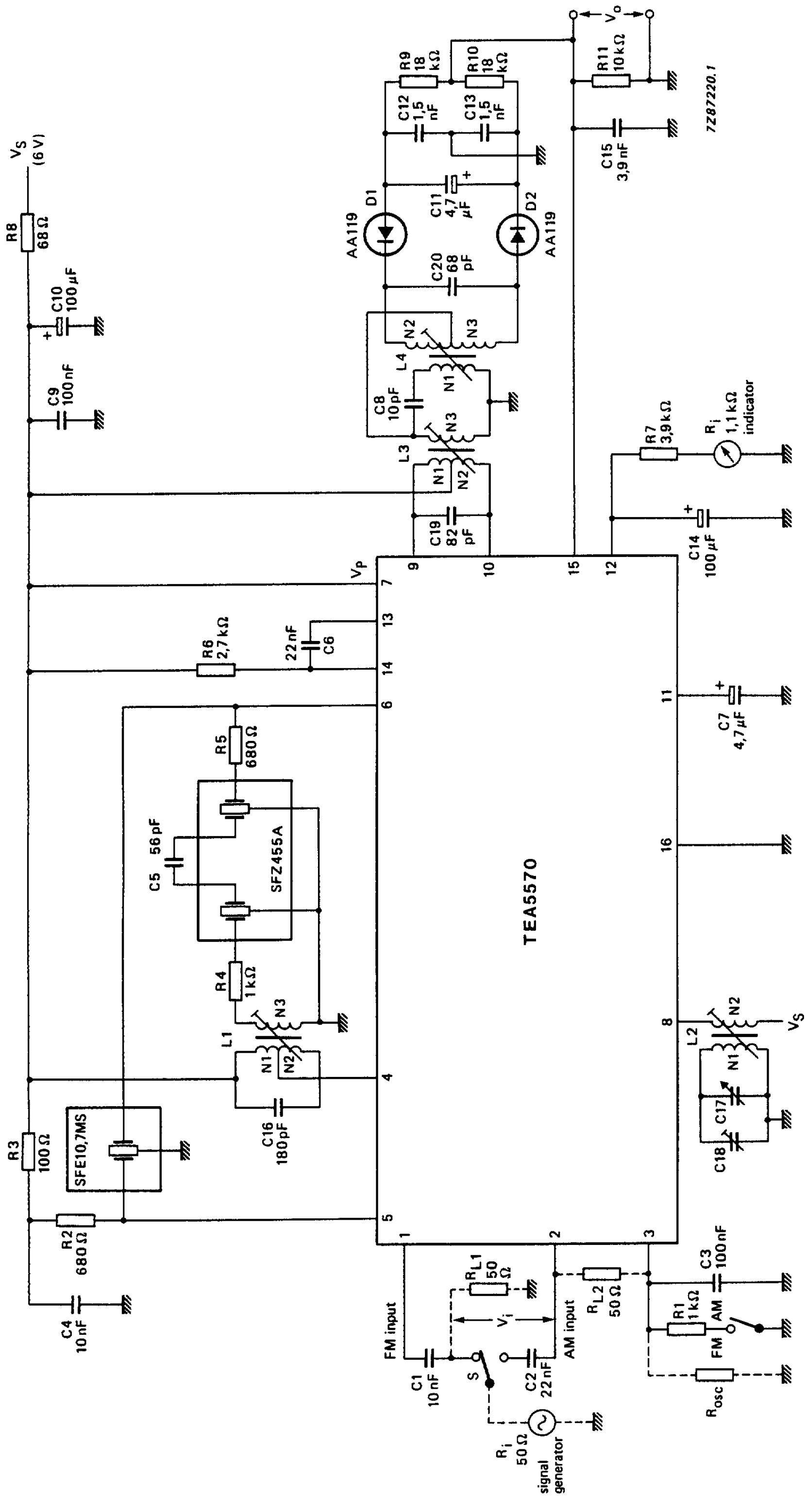


Fig.9 Indicator output current (I_{12}) and d.c. output voltage (V_{12-16}): AM f_i = 1 MHz; FM f_i = 10,7 MHz as a function of input voltage (V_i). Measured in Fig.10; V_P = 6 V; R_{12-16} = 5 kΩ.



Coil data

The transfer impedance of the i.f. filter is:

AM: $|Z_{tr}| = v_6/i_4$ = 2,7 kΩ (SFZ 455A).

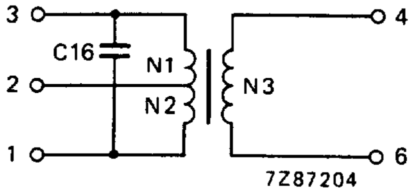
FM: $|Z_{tr}| = v_6/i_5$ = 275 Ω (SFE 10,7 MS).

See also Figs 11, 12, 13 and 14.

Fig.10 Test circuit.

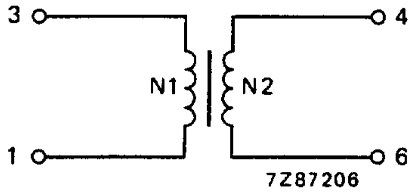
COIL DATA

AM i.f. coils (Fig.10)



N1 = 73
N2 = 73
N3 = 9
C16 = 180 pF (internal)
Wire = 0,07 mm dia.

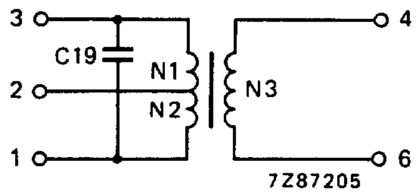
Fig.11 I.F. bandpass filter (L1). TOKO sample no. 7 MC-7 P.



N1 = 90
N2 = 7
Wire = 0,07 mm dia.

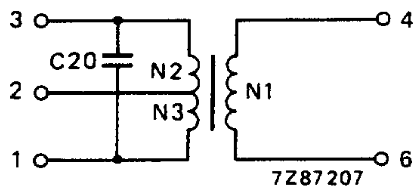
Fig.12 Oscillator coil (L2). TOKO sample no. 7 BR-7 P.

FM i.f. coils (Fig.10)



N1	=	5
N2	=	5
N3	=	4
C19	=	82 pF (internal)
Wire	=	0,1 mm dia.

Fig.13 Primary ratio detector coil (L3). TOKO sample no. 119 AN-7 P.

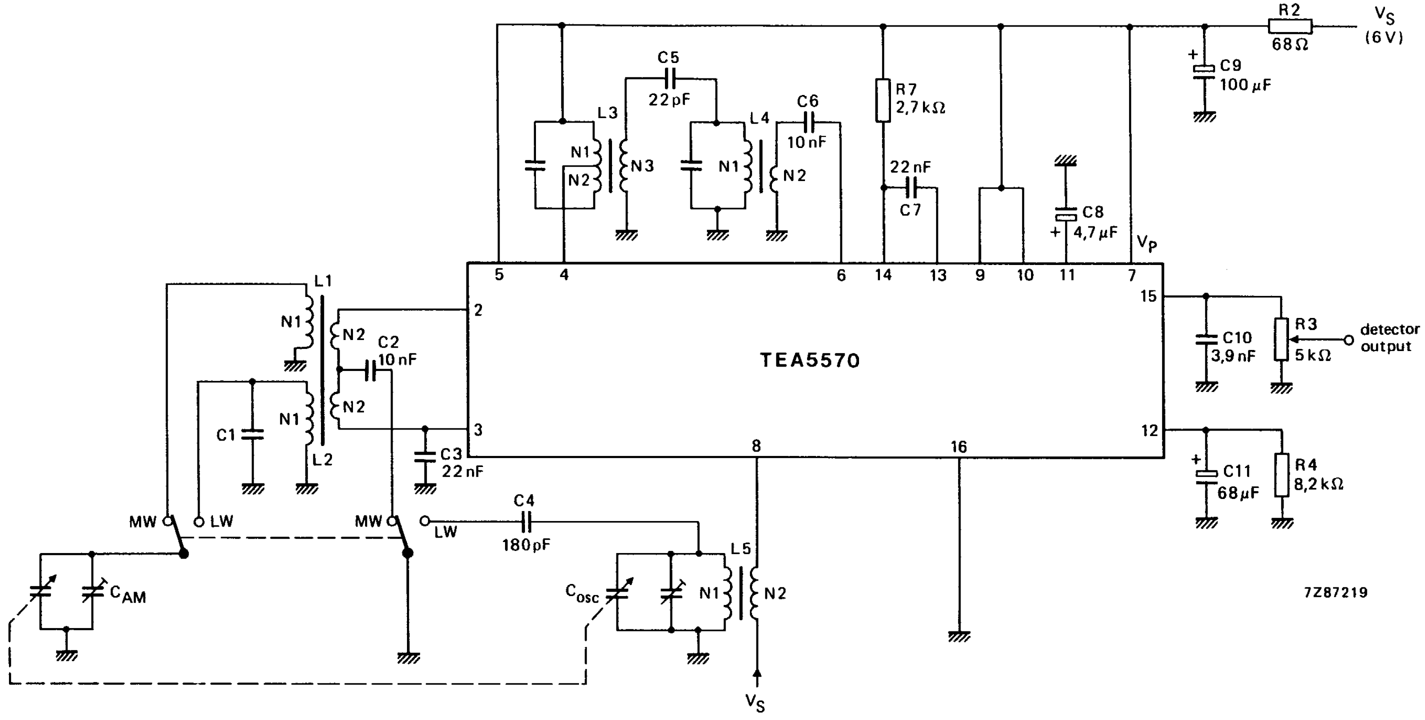


N1	=	2
N2	=	6
N3	=	6
C20	=	68 pF (internal)
Wire	=	0,1 mm dia.

Fig.14 Secondary ratio detector coil (L4). TOKO sample no. 119 AN-7 P.

APPLICATION INFORMATION

Figs 15 and 17 show the circuit diagrams for the application of 6 V AM MW/LW and 4,5 V AM/FM channels respectively, using the TEA5570. Fig.16 shows the circuitry of the TEA5570.



Coil data

L3	N1 = 73	L4	N1 = 146	L5	N1 = 90
	N2 = 73		N2 = 9		N2 = 6
	N3 = 9		C = 180 pF		
	C = 180 pF				

Fig.15 Typical application circuit for 6 V AM MW/LW reception using the TEA5570.

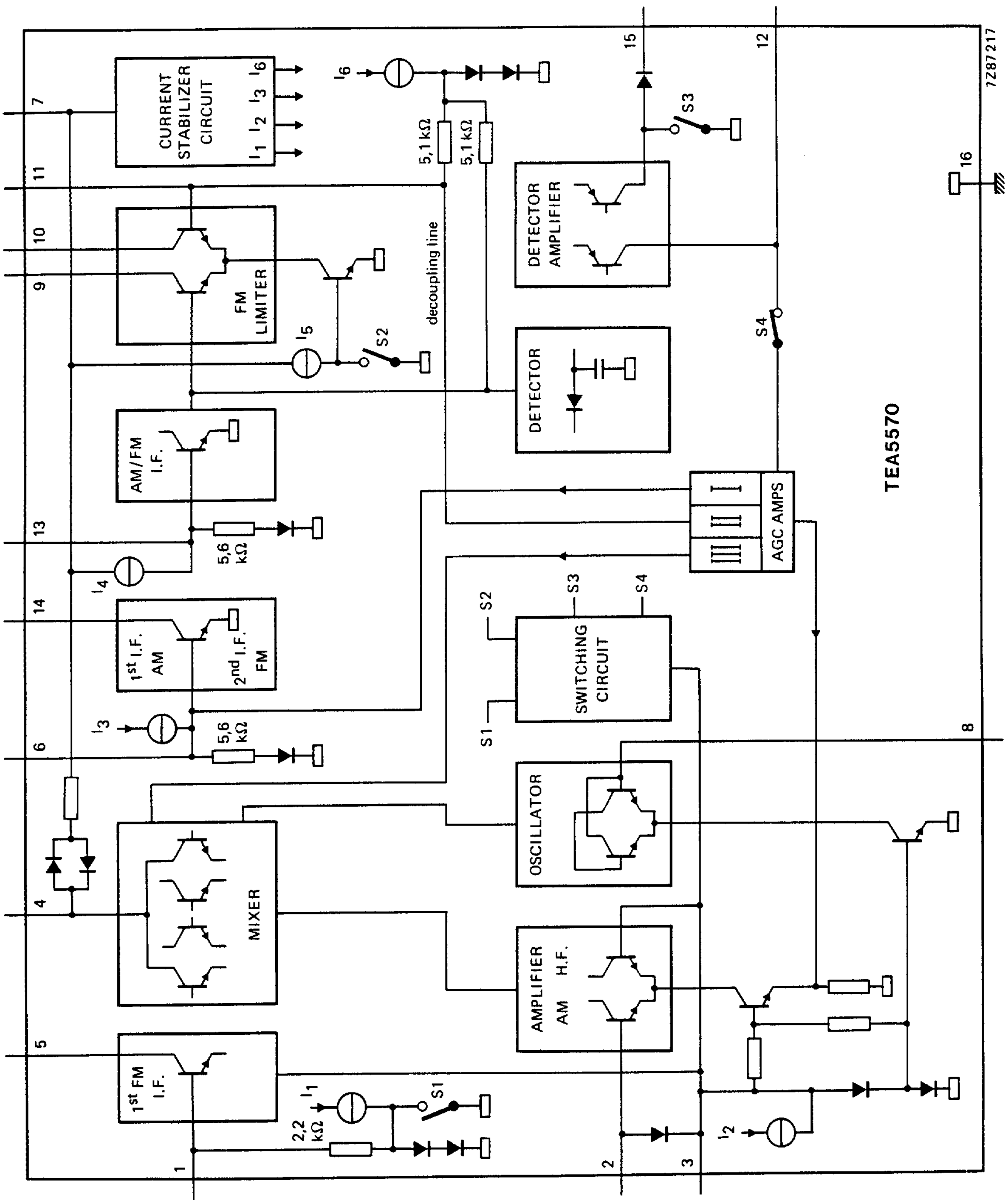
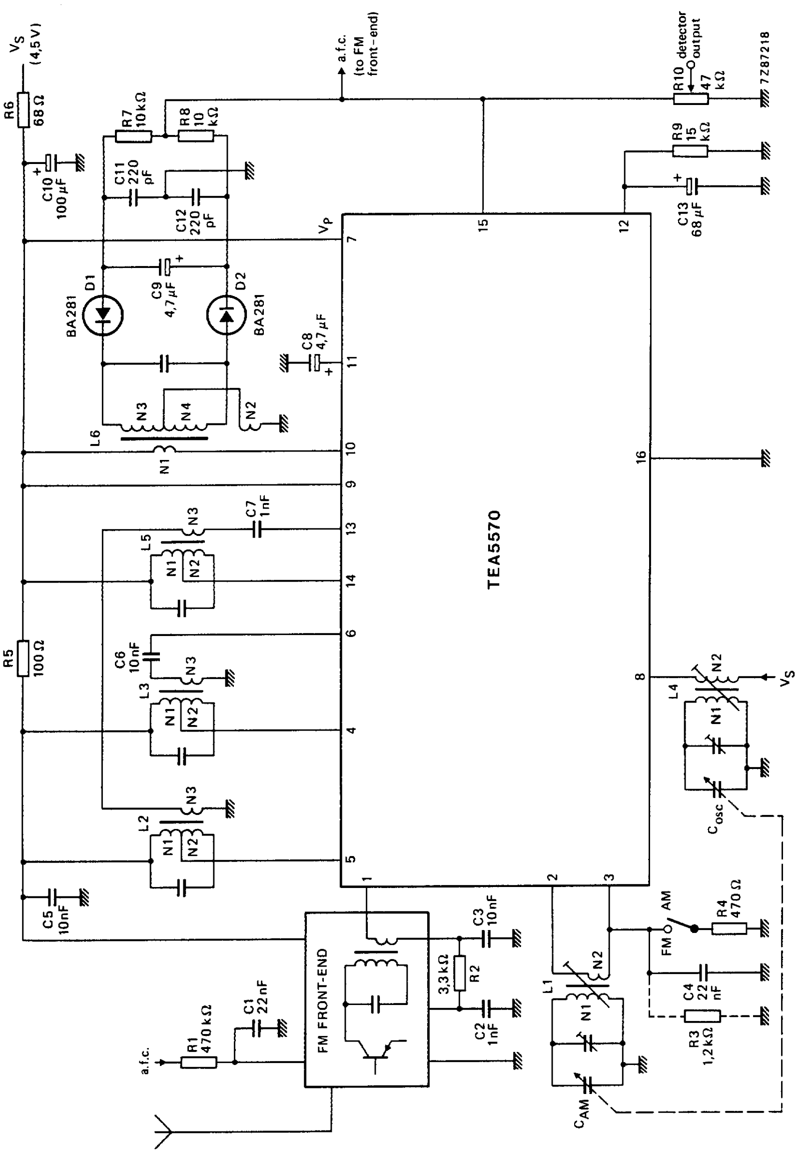


Fig.16 TEA5570 circuit diagram.



Coil data

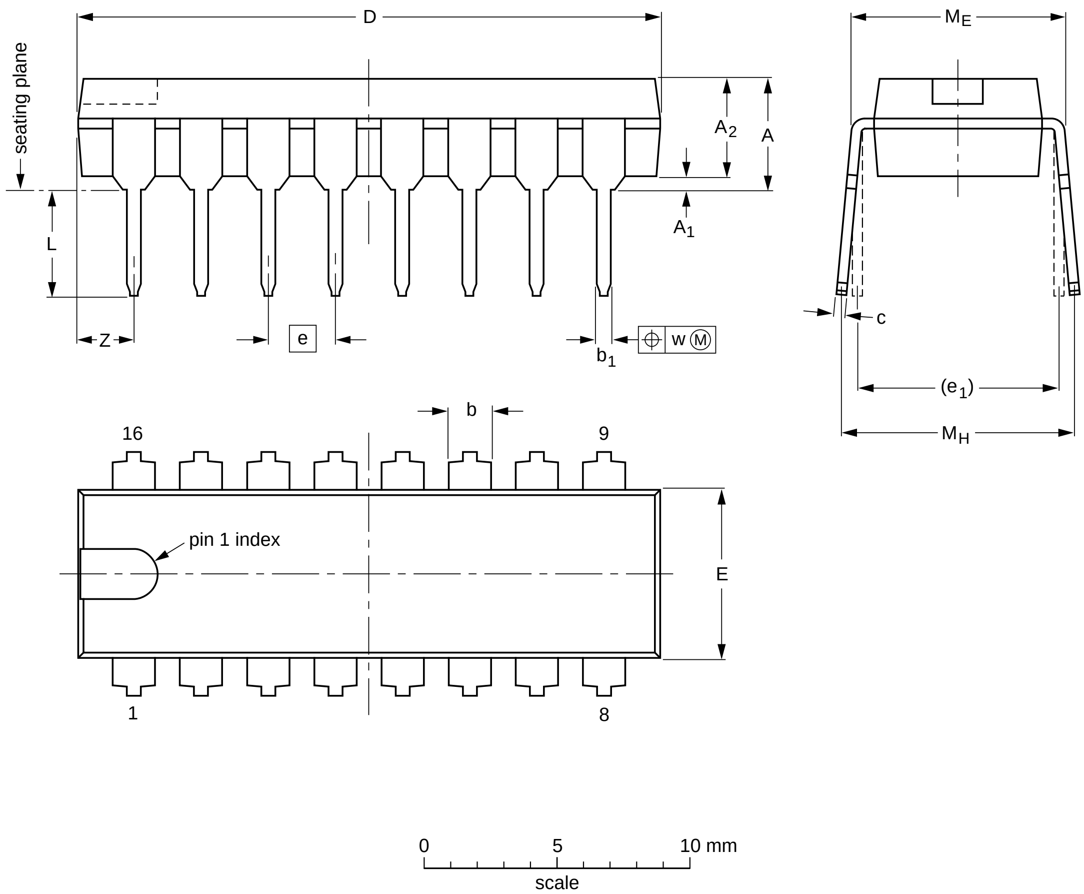
L2	N1 = 3	N2 = 8	N3 = 1	C = 82 pF	
L3	N1 = 33	N2 = 113	N3 = 9	C = 180 pF	
L4	N1 = 90	N2 = 6			
L5	N1 = 33	N2 = 113	N3 = 9		
L6	N1 = 50	N2 = 50	N3 = 4,5	N4 = 6,5	C = 82 pF

Fig.17 Typical application circuit for 4,5 V AM/FM reception using the TEA5570 with coils and single-tuned ratio detector (with silicon diodes).

DETAILED APPLICATION INFORMATION WILL BE SUPPLIED ON REQUEST.

PACKAGE OUTLINE

DIP16: plastic dual in-line package; 16 leads (300 mil); long body **SOT38-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.7	0.51	3.7	1.40 1.14	0.53 0.38	0.32 0.23	21.8 21.4	6.48 6.20	2.54	7.62	3.9 3.4	8.25 7.80	9.5 8.3	0.254	2.2
inches	0.19	0.020	0.15	0.055 0.045	0.021 0.015	0.013 0.009	0.86 0.84	0.26 0.24	0.10	0.30	0.15 0.13	0.32 0.31	0.37 0.33	0.01	0.087

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT38-1	050G09	MO-001AE				~~92-10-02~~ 95-01-19

SOLDERING

Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"IC Package Databook"* (order code 9398 652 90011).

Soldering by dipping or by wave

The maximum permissible temperature of the solder is 260 °C; solder at this temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds.

The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified maximum storage temperature ($T_{stg\ max}$). If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

Repairing soldered joints

Apply a low voltage soldering iron (less than 24 V) to the lead(s) of the package, below the seating plane or not more than 2 mm above it. If the temperature of the soldering iron bit is less than 300 °C it may remain in contact for up to 10 seconds. If the bit temperature is between 300 and 400 °C, contact may be up to 5 seconds.

DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.